Folia Forestalia Polonica, series A, 2013, Vol. 55 (3), 113–119

ORIGINAL ARTICLE

DOI: 10.2478/ffp-2013-0012

Analysis of adaptation of selected forest recreational facilities to requirements of potential users

Małgorzata Woźnicka ✉, Emilia Janeczko, Tadeusz Moskalik

Warsaw University of Life Sciences (SGGW), Faculty of Forestry, Department of Forest Utilization, Nowoursynowska 159, 02-776 Warsaw, Poland, phone: +48 22 5938133, fax: +48 22 5938139, e-mail: woznickam@wl.sggw.pl

Abstract

Both linear and aerial elements of forest recreational management should be equipped with recreational facilities which are called "small architecture". Small architecture is very diverse and serves many different functions, thus it is very important in recreation space. Recreation facilities have to be safe for potential users and offer comfort and relaxation. These conditions can be fulfilled if the construction of facilities is based on anthropometric features of the users.

In this paper, there are presented the results of analyses carried out with regard to adaptating technical parameters of selected forest facilities to potential user anthropometry. The study was conducted in Warsaw municipal forests. The analyses were based on analytical formulas, which give appropriate information about the parameters of perfectly designed facilities. Examination of technical condition of the recreation facilities analyzed was also included in the study.

Key words

anthropometry, forest facilities, ergonomics, infrastructure

Introduction

Leisure is a very important aspect in our everyday life. Everyone should know how to organize and plan their free time (weekends, holidays, etc.) taking into consideration a kind of their work, an extent of tiredness, working and living conditions and what they take pleasure in doing (Hansen 1968). In ergonomics, emphasis is put on work methods and organization and adjustment of workplace and working environment as well as adaptation of technology to abilities and needs of a human being so that the foregoing do not affect one's health. However, in order for people to fully benefit from leisure time and activities, the leisure environment should also be appropriately adapted to their needs.

Forests provide plenty of opportunities to enjoy leisure activities. The specific microclimate of forest areas aids regeneration of both physical and mental powers, and it helps to escape from civilization stress factors. One can take advantage of beneficial properties of forests both individually and together with family, regardless own age, sex or mental and physical fitness. The fact that spending leisure time in forests is not expensive is worth mentioning as well (Woźnicka and Nowacka 2001).

Received 4 January 2013 / Accepted 28 August 2013

Yet, one should bear in mind that forests will fulfill their functions only if they are appropriately developed for recreational and tourism purposes. Consequently, the processes of preparing concepts and designs of land development together with placing linear, planar and punctual elements as well as developing these elements by furnishing them with recreational facilities, which altogether create the so-called street furniture, seem to be very important. Recreational facilities provided in forests include information items (e.g. information boards, brochures), hygienic and sanitary facilities (e.g. waste containers, lavatories) and leisure facilities (e.g. benches, tables, shelters). All of the above need to be safe to potential users and increase their leisure comfort level. The abovementioned requirements can be met provided that anthropometric data of potential users are taken into account during both designing and manufacturing processes, and that appropriate maintenance actions are undertaken to ensure good technical condition of recreational facilities in use.

The aim of this paper was to present the requirements of users as regards chosen forest recreational facilities.

Ergonomics in designing forest recreational facilities

PN-EN ISO 6385 standard concerning the principles of ergonomics in designing work systems as well as Nowacka (2002) point out that ergonomic design principles should be applied in all fields of human activity as they place special emphasis on health and safety of human beings. Designing elements of man's immediate environment in line with the principles of ergonomics allows to come up with both custom solutions – specifically tailored to morphological features and fitness levels of particular users and universal solutions – adjusted to needs of a broad spectrum of users. Such a design process needs to use the findings of anthropometric research (Nowak 1993), as anthropometry investigates human physical variation in time and space, and in particular it focuses on racial diversity, ontogenetic variability as well as ontogenetic and phylogenetic development. Anthropometric atlases containing data on anthropometric features of inhabitants of particular regions should be available in every country. One of such sources used in Poland is the anthropometric atlas 'Altas miar człowieka' (Gedliczka 2001). Other sources of anthropometric data on the European population contained in the PN-EN ISO 14738 and PN-EN 547-3 standards can also be used.

As it has already been stated above, providing forests with different types of facilities is very important for increasing their recreational value. The number of such facilities should depend on the development density of a given area and the projected attendance of users. Łonkiewicz and Głuch (1991), Ważyński (1997) and Pieńkos (1998) emphasize that a form of recreational facilities in forests should be simple and esthetic. The objects should be made of uniform materials, which does not imply they should be invisible (Janeczko 2010) – on the contrary, their sometimes expressive architectural form could enrich the landscape they are situated in. Such facilities should be made of wood, and only some of their components should be made of metal or stone. Nowacka and Woźnicka (2001) stress that recreational facilities have to increase the comfort of their users, need to be safe and they cannot pose any threats to human health.

One of the groups of basic recreational facilities for passive leisure time pursuits in forests and woodland areas are tables, seats and shelters. Seats are free-standing objects placed under open sky or under shelters, which are pieces of equipment of both linear and planar objects. They can be either movable or permanently affixed to the ground. Benches placed along trails should be located at the berms, so that tourists can move freely along trails and sitting persons can rest undisturbed. According to Łonkiewicz and Głuch (1991), the Forest Research Institute, Poland (IBL) recommends the following technical parameters of seats: width – 0.3–0.5 m; length – n x 0.5 m; height – 0.4–0.5 m; backrest height – 0.35–0.40 m. Recommended technical parameters for stools are as follows: diameter – 0.35–0.40 m; length – 0.35–0.40 m; height – 0.45–0.50 m. If a bench is equipped with a backrest, it should be sloped at an angle of 5–10°, and in such case its height can be reduced to 0.35 m. However, according to Nowak (1993):

– a bench which is too high or too narrow puts pressure on blood vessels of the back of thighs, which

affects bloods circulation and may lead to leg swelling and numbness;
– a bench which is too short forces unnatural position of legs, which are drawn in and press internal organs, whereas the weight of entire body is received by the ischial tuberosity. The organs pressured do not function correctly, and the pressure on the ischial tuberosity impedes blood circulation in lower extremities. One can stretch their legs to avoid discomfort; however, stretched legs position gives no feeling of safety or balance.

Backrests, if any, should consist of the following elements:
– lower rest – supports the lumbar vertebrae,
– middle rest – supports the thoracic vertebrae up to arms,
– upper rest – supports the neck and head.

The backrest should be bent at an angle of 135° to the seat (when resting). When equipping benches with backrests, the plane of the seat should be sloped by 3–5° back. The angles and sizes of seats should be appropriately adjusted so that the feet of a person sitting on the bench rest on the ground.

Just like seats, tables can also be a part of recreational equipment placed in forests. IBL guidelines give only one requirement which tables have to meet: the height of table top position, which should be 0.70–0.75 m. At the same time, Nowak (1993) states that:
– a table which is too low forces a user to stretch legs, which results in no feeling of safety or balance,
– a table which is too high forces a person to hold arms in an unnatural position, which tires muscles, causes disruption in blood circulation and may result in arm numbness.

There are no guidelines as to the lower manipulation height of tables. Also, a distance between the table and the seat is important for comfort of the user.

Shelters are the structures which can perform their functions individually or can come with other recreational facilities. Their purpose is to provide shelter from inclement weather and to give cover while resting or preparing and consuming meals. Shelters should be 2.50–3.50 m high. In most cases, shelters cover seats and tables which are placed underneath.

Material and methods

It was decided to investigate whether leisure facilities available in urban forests of Warsaw enhance comfort and safety of tourists. To that end, an analysis of adjustment of technical parameters of these facilities to potential users' anthropometric data was conducted Also, technical condition of the facilities analyzed was examined.

All leisure facilities (i.e. benches, tables, seats, shelters) located within the area of eight urban woodland areas of Warsaw were studied. The following parameters were measured in the cases of particular facilities:
– seats – depth or diameter, height from the ground,
– shelters – height at the entrance under a shelter, width and height of free space between the vertical projection of roof supports on the ground and the outer edge of a bench,
– tables – lower manipulation height, upper table top height, distance between the edge of a table and the inner edge of a seat,

Aside from technical parameters, descriptive characteristics were used to evaluate the technical condition of facilities with a four-grade scale:
– grade 1 – very good technical condition of a facility; no signs of deficiencies, scratches, etc.,
– grade 2 – good technical condition of a facility; visible cracks, burns and/or scratches, but with no influence on the usable value of the facility,
– grade 3 – poor technical condition of a facility; clearly visible defects, which may result in injuries (e.g. sharp edges, protruding nails, unstable structure) or significantly reduce user's comfort (e.g. holes burnt in the table top); also, facilities which cannot perform their functions properly (e.g. due to no shingles on the roof of a shelter),
– grade 4 – bad technical condition of a facility; very serious defects – a facility cannot perform its designated purpose.

For the purpose of the analysis of a level of adjustment of selected recreational facilities to the needs of the category of potential able-bodied users, comfort formulas suggested by Grandjean and adapted by Nowacka (in: Majewski 2003) were applied. These formulas take into account comfort coefficients related to heel height, clothes volume (trousers, jackets), etc.:

1. seats

$$G = 2/3 \times U + b \text{ [cm]} \quad (1)$$

$$Ws = Wp + a \text{ [cm]} \quad (2)$$

2. tables

$$Wm = 0.8 \times (H + Wp) \text{ [cm]} \quad (3)$$

$$Wmd = Wn + 19 \text{ [cm]} \quad (4)$$

3. shelters

$$Wws = Wc + a + 25 \text{ [cm]} \quad (5)$$

$$Www = Wc + a + 25 \text{ [cm]} \quad (6)$$

Taking into account the principles of ergonomic design, the following formulas for the diameter of a tree stump used as stools and the width of free space under shelters have been developed:

$$Gø = Ssb + b \text{ [cm]} \quad (7)$$

$$Swe = Msc + c \text{ [cm]} \quad (8)$$

The formulas and design guidelines lack recommendations concerning a distance between the table and the bench, when both objects are permanently fixed (in parallel to each other). At the same time, the value of this parameter mentioned in IBL guidelines (0.05–0.10 m) seems to be insufficient. Therefore, taking into account a casual sitting position at the table, and considering the fact that too large a distance results in bending over the table top, and too short a distance makes it difficult to sit down and get up from the table, the following solution were suggested:

$$OD = 10 – 15 \text{ cm}$$

Explanations:

– Technical data:
  G – seat depth,
  Gø – seat diameter,
  OD – distance between the vertical projection of the edge of a table on the ground and the inner edge of a seat,
  Swe – width of the free space (distance between the vertical projection of the roof supports on the ground and the outer edge of a seat),
  Wm – upper manipulation height of a table,
  Wmd – lower manipulation height of a table,
  Ws – seat height,
  Wws – height at the entrance under a shelter,
  Www – inner height of a shelter over the spot between the vertical projection of the roof supports on the ground and the outer edge of a seat.
  Anthropometric data:
  Msc – Msc – elbow-to-elbow, standing,
  Ssb – hip width, sitting,
  U – thigh depth, sitting,
  Wc – body height,
  Wp – popliteal height.
– Comfort coefficients:
  a – height = 3 cm,
  b – width = 6 cm,
  c – depth = 7 cm.

Based on the above formulas, anthropometric data included in the anthropometric atlas (Gedliczka 2001) and in PN-EN ISO 14738 standard (for Europe's population), the parameters of ideally designed facilities were elaborated. The 5th, 50th and 95th centiles of the anthropometric data selected were used in the designs (tables 1, 2 and 3). In case of 5th centile value, in most cases the anthropometric data of women were used – the only exception was the value of hip width, sitting. The value for 50th centile was calculated based on the arithmetic mean of 50th centiles for both men and women. In case of 95th centile, only the anthropometric data of men were taken into account.

Tab. 1. Parameters of ideal seat

Technical parameter	Anthropometric Atlas			PN-EN ISO 14738		
	5C	50C	95C	5C	50C	95C
Ws [m]	0.435	0.476	0.529	0.410	0.474	0.525
G [m]	0.373	0.419	0.477	–	–	–
Gø [m]	0.390	0.429	0.489	0.393	0.428	0.500

„–" no anthropometric data (it is recommended to use country-specific, local anthropometric data).

Tab. 2. Parameters of ideal table

Technical parameter	Anthropometric Atlas			PN-EN ISO 14738		
	5C	50C	95C	5C	50C	95C
Wm [m]	0.727	0.815	0.919	0.708	–	–
Wmd [m]	0.651	0.708	0.786	0.650	0.720	0.792

„–" no anthropometric data.

As in accordance with design principles each facility should be adjusted to needs of 90% of potential

users, a table respecting three ranges of values: up to 5C, between 5C and 95C and above 95C, was used. However, when defining scope of adaptation of a given facility, one should remember that the following parameters: seat height and upper height of a table should be adjusted to the values of 5C-95C range, whereas the following parameters: seat depth, lower manipulation height of a table, height at the entrance under a shelter and its inner height as well as the width of free space under a shelter should be adjusted to the values of 95C range.

Tab. 3. Parameters of ideal shelter

Technical parameter	Anthropometric Atlas			PN-EN ISO 14738		
	C5	C50	C95	C5	C50	C95
Wws [m]	1.782	1.950	2.142	1.810	1.999	2.161
Www [m]	1.782	1.950	2.142	1.810	1.999	2.161
Swe [m]	0.453	0.542	0.645	0.450	0.536	0.600

Results

A total of 1453 free-standing seats, including 69 tree stumps used as stools were analyzed. Also, the study covered 151 tables with 324 accompanying benches and 64 shelters.

As for seat height, 39% of free-standing benches (for Poland-specific anthropometric data) showed to be in accordance with ergonomic guidelines (52% for European anthropometric data) (tab. 4), whereas only 28% of these facilities turned out to provide comfort to the majority of their users. Only 13% of all the seats offered correct parameters both of the height and depth. In 50% of benches accompanying tables, the height of seats complied with the requirements (for Poland-specific anthropometric data), and in 67% of facilities this parameter was correct for Europe's population anthropometric data. Only 1% of benches met user expectations concerning the ideal depth. In approximately 50% of tables, the upper manipulation height provided comfort to the majority of users, whereas only 2% of these facilities offered appropriate lower manipulation height. The distance between the bench edge and table complied with the recommendations only in case of 5% of facilities; in 93% of cases this distance was too large, and in 2% it was too small. In 85% (for Poland-specific anthropometric data) and in 78% (European anthropometric data) of shelters, the height at the entrance under a shelter guaranteed operational safety; however, the height inside a shelter was appropriate in only 2% of facilities. Also, the width of free space under a shelter was appropriate only in 2% (based on Poland-specific data) and 5% (based on European data) of facilities (tab. 4).

Tab. 4. Compliance of technical parameters of recreational facilities in selected urban forests of Warsaw with anthropometric data

Type of facilities	Parameter	Total number of facilities	Anthropometric Atlas						PN-EN ISO 14738					
			below C5		between C5 and C95		above C95		below C5		between C5 and C95		above C95	
			n	%	n	%	n	%	n	%	n	%	n	%
Seat	Ws	1439	696	48.4	566	39.3	177	12.3	513	35.6	756	52.5	170	11.8
	G	1439	593	41.2	438	30.4	408	28.4	63*	91.3	5*	7.2	1*	1.5
Bench	Ws	324	99	30.6	161	49.7	64	19.8	44	13.6	217	67.0	64	19.8
	G	324	270	83.3	51	15.7	3	0.9	3*	75.0	1*	25.0	0*	0.0
Table	Wmg	151	73	48.3	73	48.3	5	3.3	–	–	–	–	–	–
	Wmd	147	125	85.0	19	12.9	3	2.0	121	82.3	23	15.6	3	2.0
Shelter	Wws	64	2	3.1	7	10.9	55	85.9	2	3.1	12	18.8	50	78.1
	Www	64	37	57.8	20	31.3	7	10.9	39	60.9	18	28.1	7	10.9
	Swe	128	106	82.8	20	15.6	2	1.6	97	75.8	24	18.8	7	5.5

* tree stumps.
Marked in grey – adjusted to needs of the majority of users.

The majority of recreational facilities in urban forests of Warsaw was in very good or good technical and operational condition (tab. 5). Defects and damages resulting in poor and bad technical condition were regularly found in seats (6.7% – class 3 and 4) and shelters (4.7%). In class 4, the condition of seats was so bad that it was impossible to measure technical parameters of these facilities.

Tab. 5. Technical and operational condition of recreational facilities in selected urban forests of Warsaw

Class of technical condition	Type of facility							
	seat		bench		table		shelter	
	n	%	n	%	n	%	n	%
1	848	58.3	292	90.1	95	62.9	54	84.4
2	508	35.0	31	9.6	53	35.1	7	10.8
3	81	5.6	0	0.0	2	1.3	2	3.1
4	16	1.1	1	0.3	1	0.7	1	1.6
Total	1453	100.0	324	100.0	151	100.0	64	100.0

Discussion

The importance of the issue of fitting recreational forest facilities with anthropometric characteristics of potential users seems to be underestimated to a large extent by both forest administration personnel and scientists. In Polish subject literature, there are a few publications dealing with the question of interest, and likewise – no research results are available that would cope with ergonomic aspects of recreation-related facilities not only within the State Forests, but also – in the national or city parks. On the other hand, however, both foresters and scientists analyze expenditures connected with the production and maintenance of forest recreation facilities as well as their resilience against man's activity and weather impacts (Hyży 2011). Opinions are more and more frequently expressed which emphasize the necessity of making particular items of forest recreation facilities available to capabilities and needs of people with disabilities (Woźnicka 2010; Nowacka 2011; Hyży 2011). These attempts should also take into account anthropometric parameters of the disabled, and especially forest visitors moving on wheelchairs: these anthropometric data are significantly different from standard ones. This approache is a result of both recently introduced legal regulations and public campaigns.

There are also analyzed forms and shapes of forest recreational facilities, an extent to which they fit surrounding vicinity as well as materials they were produced of. According to Janeczko (2011) and Czerwiński (1985), all facilities constituting the so called small architecture in forest should compose a holistic entity harmonized with the landscape. Scientific activities are performed aiming at harmonizing small architecture with local traditions and construction standards. It seems however, that the facilities of forest recreation spots should first of all be functional and supply all visitors with possibly most effective rest.

Conclusions

- Technical parameters of recreational facilities in urban forests of Warsaw do not take into account anthropometric data of the category of able-bodied users; thus, they do not improve user comfort.
- In most cases, recreational facilities in urban forests of Warsaw are in good and very good technical condition.
- It seems that seat and table technical parameters strongly depend on the parameters of material they are made of as well as on inventiveness of their manufacturers.
- Good technical condition of the facilities studied shows that they are inspected on regular basis and whichever damages or defects are repaired with dispatch.

References

Czerwiński H. 1985. Budownictwo leśne. Wydawnictwo SGGW-AR, Warszawa.

Gedliczka A. 2001. Atlas miar człowieka. Dane do projektowania i oceny ergonomicznej. CIOP, Warszawa.

Hansen A. 1968. O sztuce wypoczynku. Wydawnictwo Związkowe CRZZ, Warszawa.

Hyży M. 2011. Parking leśny jako przykład infrastruktury leśnej – stan obecny i przyszły, koszty, stan-

daryzacja, współpraca. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej*, 13 (1), 171–174.

Janeczko E. 2010. Ścieżki edukacyjne jako element rekreacyjnego zagospodarowania lasu. In: Las i edukacja leśna bez barier – kształtowanie postaw ekologicznych. LZD SGGW, Rogów.

Janeczko E. 2011. Infrastruktura rekreacyjno-edukacyjna jako element krajobrazu leśnego. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej*, 13 (1), 14–19.

Łonkiewicz B., Głuch G. 1991. Wytyczne turystycznego zagospodarowania lasów. IBL, Warszawa.

Majewski P. 2003. Analiza czynników warunkujących bezpieczeństwo i komfort wypoczynku rekreacji w Nadleśnictwie Bobolice. Praca magisterska wykonana w Katedrze Użytkowania Lasu pod kierunkiem dr inż. Wiesławy Ł. Nowackiej. Warszawa.

Nowacka W.Ł. 2002. Forest recreation facilities from the point of view of ergonomics. Theory and practice. Proceeding of International Seminar on New Roles of Plantation Forestry Requiring Appropriate Tending and harvesting Operations. September 29 – October 5, 2002, Tokyo, Japan.

Nowacka W.Ł. 2011. Projektowanie leśnej przestrzeni turystycznej z punktu widzenia niepełnosprawnego użytkownika. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej*, 13 (1), 30–39.

Nowak E. 1993. Antropometria na potrzeby projektowania. *Prace i Materiały Instytutu Wzornictwa Przemysłowego*, 145.

Pieńkos K. 1998. Plan zagospodarowania lasów do celów rekreacji. In: Rola planu inżynieryjnego zagospodarowania lasu w wielofunkcyjnej zrównoważonej gospodarce leśnej. Materiały z sympozjum. Warszawa.

PN-EN ISO 6385 Zasady ergonomiczne w projektowaniu systemów pracy.

PN-EN 547-3 Maszyny – Bezpieczeństwo – Wymiary ciała ludzkiego – Dane antropometryczne.

PN-EN ISO 14738 Maszyny – Bezpieczeństwo – Wymagania antropometryczne dotyczące projektowania stanowisk pracy przy maszynie.

Ważyński B. 1997. Urządzanie i zagospodarowanie lasu dla potrzeb turystyki i rekreacji. Wydawnictwo AR im. A. Cieszkowskiego w Poznaniu, Poznań.

Woźnicka M., Nowacka W.Ł. 2001. Organizacja miejsc wypoczynkowych z punktu widzenia ergonomii. *Roczniki Akademii Rolniczej w Poznaniu, Leśnictwo*, 39, 265–269.

Woźnicka M. 2010. Zagospodarowanie rekreacyjne lasu w kontekście potrzeb osób niedowidzących i niewidzących. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej*, 12 (1), 183–189.